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3M Paradigm™

MZ100 Block

Technical Product Profile



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Product Description

3M™ Paradigm™ MZ100 Block for CEREC® is a strong, wear-resistant, and esthetic mill block that provides a fast and easy-to-use alternative to porcelain blocks for CEREC restorations. Paradigm MZ100 blocks are made from 3M™ Z100™ Restorative material under optimized process conditions that assure thorough cure and a high degree of crosslinking. This process contributes to excellent physical properties and clinical performance. Paradigm MZ100 blocks are designed for use in the CEREC system, and are mounted on a mandrel for use in CEREC machines. Paradigm MZ100 material is radiopaque. Paradigm MZ100 restorations are bonded to tooth structure with an adhesive resin cement such as 3M™ RelyX™ ARC Adhesive Resin Cement.

Paradigm MZ100 blocks are made in two cylindrical sizes, 10 and 14; these correspond to the CEREC sizes according to the following conversion:

CEREC Size I8, I10 = 3M Size 10

CEREC Size I12, I14, V5-12, V7, K14 = 3M Size 14

Paradigm MZ100 blocks are available in 6 popular shades:

- Enamel (E) - a more translucent shade
- A1, A2, A3, A3.5
- B3

Indications for Use

Paradigm MZ100 blocks are indicated for use in the following types of restorations.

- Inlays
- Onlays
- Veneers
- Full Crowns

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Key Product Features

- Proven 3M™ Z100™ Restorative performance
- Easier to finish and polish
- High strength and toughness
- Low wear, kind to natural dentition
- No firing and glazing: less time, less equipment, saves space
- Easier to make add-on adjustments
- Superb esthetics
- Metal-free restoration
- Consistent quality assured through precise process control
- Excellent bond to enamel and dentin with 3M™ RelyX™ ARC Adhesive Resin Cement

3M™ Paradigm™ MZ100 Block for CEREC® 2700TK



3M™ Paradigm™ MZ100 Block for CEREC® Refill Kits 2710 and 2714



3M™ Paradigm™ MZ100 Blocks A1/14, A1/10



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Background

The introduction of CEREC® in 1988 brought about a new concept to dentistry, described as the chairside CAD/CAM fabricated indirect restoration. Relentless research to improve these systems have resulted in the current trio of CEREC® 2 with CEREC *Link*®, CEREC® 3, and CEREC *Scan*® (Sirona Dental Systems GmbH, Bensheim, Germany), which can produce all types of single-unit restorations (inlays, onlays, veneers, crowns). Dental laboratories have also discovered the productivity and other benefits of the CEREC system.

The market for indirect restoratives has been fueled by several trends in recent years, including (Karapetian, et al):

- increasing development, acceptance, and use of CAD/CAM technology
- desire to reduce or eliminate use of metals
- increased emphasis on esthetics

These trends have led to increased use of ceramic and composite for indirect restorations, and have contributed to the growing use of the CEREC system. While a wide variety of composites are available from dental laboratories, only porcelain blocks are currently available for coreless restorations for the CEREC system. 3M™ Paradigm™ MZ100 Block for CEREC® is the first composite block sold for use with the CEREC system.

Discussions with CEREC users revealed that they place a high value on strength, esthetics, and low wear. Clinical evidence of performance is the best test of a material's trustworthiness, according to the users. While they readily go to great lengths to craft fine restorations, there was also great interest in a material that is easier to use. Although porcelains are widely accepted and used, they have several drawbacks:

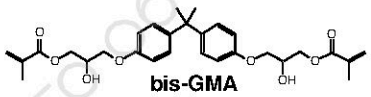
- difficult to adjust, requiring more time to obtain good contacts and occlusion
- sometimes require glaze firing to obtain sufficient mechanical strength
- characterization requires firing
- etching with hydrofluoric acid
- abrasive to opposing dentition
- five or more sizes of blocks to inventory
- fragile during try-in

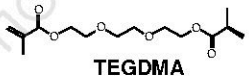
An objective for 3M Dental was to develop a material that would provide outstanding strength and wear properties for single unit restorations, while eliminating some of the drawbacks of porcelain. For this reason, one of the world's leading restoratives, 3M™ Z100™ Restorative material, was an excellent candidate for development into an industrially cured block for the CEREC system.

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Chemistry

3M™ Paradigm™ MZ100 Block for CEREC® is made from 3M™ Z100™ Restorative Material. Paradigm MZ100 block material contains 85 wt% ultrafine zirconia-silica ceramic particles that reinforce a highly crosslinked polymeric matrix. The polymer matrix consists of bisGMA (Bisphenol A diglycidyl ether dimethacrylate) and TEGDMA (tri[ethylene glycol] dimethacrylate), and employs a patented ternary initiator system.

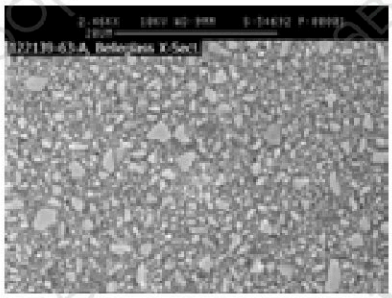




The ultrafine zirconia-silica filler particles are synthesized by a patented sol-gel process that results in a unique structure of nanocrystalline zirconia dispersed in amorphous silica. The particles have a spherical shape, and an average particle size of 0.6 micrometer. This contrasts sharply with milled glass fillers in conventional hybrid composites. The filler imparts radiopacity, wear resistance, and strength.



3M™ Paradigm™ MZ100 SEM
2500x



Belleglass™ SEM
2500x

These filler and polymer components yield a resilient composite with excellent strength and wear, high polishability, lifelike esthetics, and superb milling characteristics.

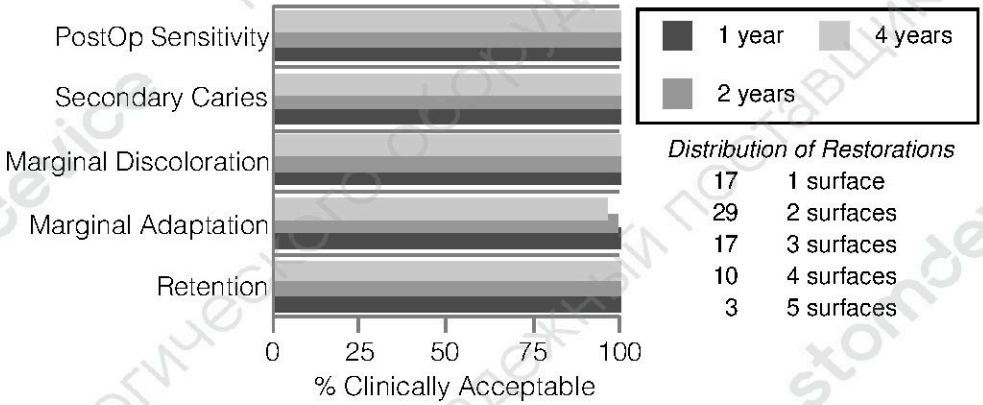
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Clinical History

3M™ Z100™ Restorative material has been commercially available since 1992, and in clinical use since 1990. It is one of the global market leaders in composites, with over 150 million restorations placed. In addition, Z100 restorative is indicated and used for indirect restorations. Since 3M™ Paradigm™ MZ100 Block for CEREC® is made from cured Z100 restorative, it is expected that the clinical performance of Paradigm MZ100 blocks will be equal to or better than that of directly placed Z100 restorative.

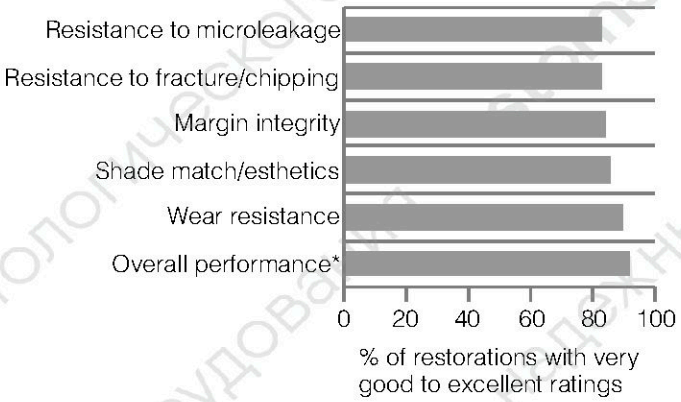
In a study at the University of Manitoba reporting four year data for Z100 restorative in Class I and II restorations in molar teeth (Suzuki), of the 76 restorations evaluated, 73 were clinically acceptable. Of the three restorations that required replacement, two had fractured (in the same patient) and one was replaced because of a marginal defect. The average wear of Z100 restorative from baseline to 4 years was 39µm. The author concluded that Z100 restorative maintained excellent anatomic form and color stability, and exhibited good durability.

Figure 1.
3M™ Z100™ Restorative
4-Year Clinical Results,
University of Manitoba



The Dental Advisor (Farah, et al, 1998) reported on a 5-year clinical evaluation of Z100 restorative. One hundred sixty-six restorations were placed in 76 patients by eight operators. One hundred thirteen of the restorations were in posterior teeth of which 85% or more received a rating score of 'very good' to 'excellent' for resistance to fracture or chipping, marginal integrity, wear resistance, shade match, and esthetics. Two of the restorations needed replacement. More recently, *The Dental Advisor* (Farah, et al. 2000) reported on the 7-year performance of Z100 restorative material. Their conclusion was: "Differences in performance between the 5 and 7 year recall were minimal. Overall, 3M Z100 Restorative performed exceptionally well at the 7 years in all categories evaluated." The clinical results were: of the 79 restorations evaluated, 82% or more received a "very good" to "excellent" rating.

Figure 2.
3M™ Z100™ Restorative
7-Year Clinical Results,
The Dental Advisor



* It is important to note that the overall performance does not represent an average of the categories evaluated. It reflects the clinicians overall satisfaction with Z100 restorative.

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Lambrechts *et al* of the Catholic University of Leuven measured the occlusal contact area wear of 3M™ Z100™ Restorative material used to restore first and second molars using a computerized technique accurate to within 1 µm. The vertical wear in microns over four years was measured and compared with the average enamel wear. The four year clinical results of contact-free occlusal areas (CFOA) and occlusal contact areas (OCA) demonstrated that Z100 restorative material has wear similar to amalgam. Additionally, the wear rate of Z100 restorative material on enamel in occlusal contact areas was comparable to the occlusal contact wear for enamel on enamel. In an ideal situation, the wear of material from a restorative should match that of enamel.

Figure 3.
Four-Year In Vivo Wear 3M™ Z100™ Restorative and Amalgam, Catholic University of Leuven

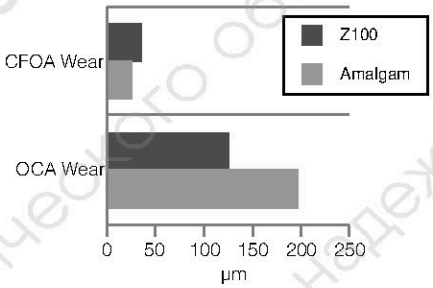
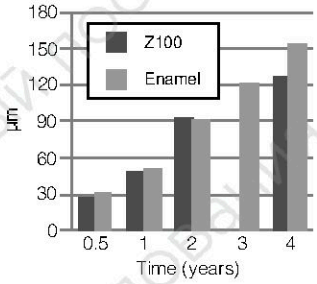
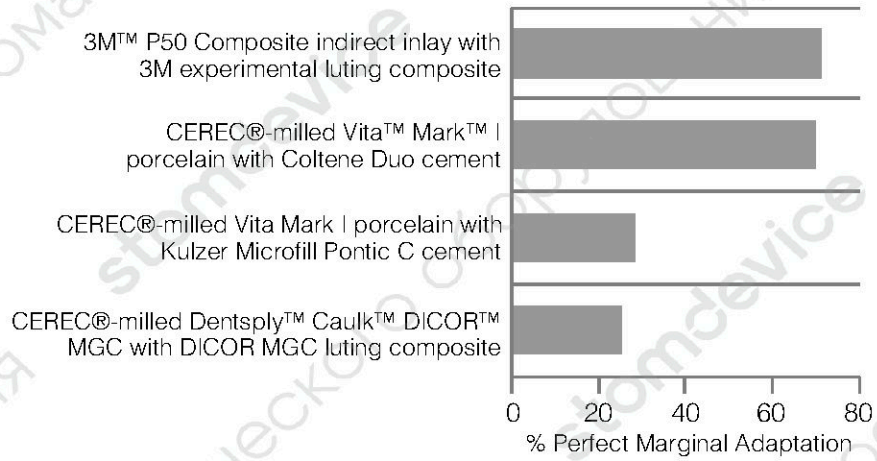


Figure 4.
In Vivo Wear Resistance 3M™ Z100™ Restorative and Enamel, Catholic University of Leuven



A study by Gladys *et al* compared three types of CEREC® milled inlays with a laboratory fabricated composite control. The materials tested were two types of preformed porcelain blocks, a preformed glass block, and 3M™ P50™ Composite. The bisGMA-TEGDMA resin and zirconia-silica filler in P50 composite is similar to those in the 3M™ Paradigm™ MZ100 block. The blocks were used to mill 24 Class II inlays, eight per group, and a further eight composite inlays were laboratory made utilizing P50 composite. The 32 restorations were placed in 20 patients and evaluated over three years. At three years all the restorations were scored as being clinically satisfactory with no marginal discoloration or secondary caries. The P50 composite inlays had the best marginal adaptation at the inlay-lute interface, with no difference between groups for marginal adaptation at the enamel-lute interface. Evaluation of replica models under SEM detected some marginal degradation for all four systems at the 6 month recall. The preformed glass blocks showed the highest number of fractures at the inlay margin.

Figure 5.
Three-Year Marginal Adaptation, Gladys, et al



It is well documented that use of resin composite in an indirect procedure goes some way to reduce the technique sensitivity of direct placement composite, particularly when used to restore a large multi-surface cavity (Bausch, et al; Burke, et al).

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Technique Guides

3M PREPARATION GUIDE

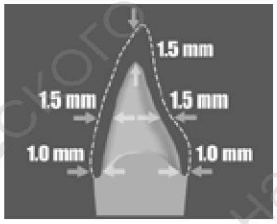
3M™ Paradigm™ MZ100 Block for CEREC®

CAD Design:

Minimum material thickness:

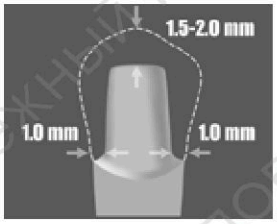
To guarantee clinical success, the following minimum material thickness should be adhered to:

Anterior



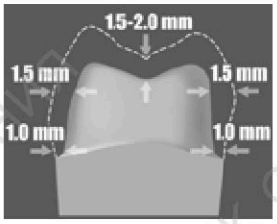
1

Premolar

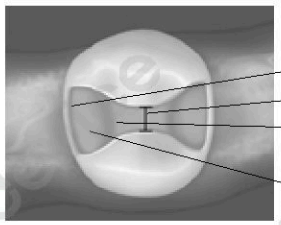


2

Molar

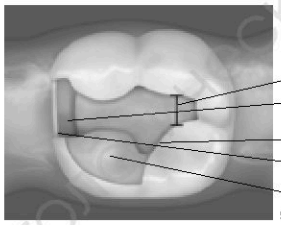


3


4

Premolar Inlay Preparation

- Butt joint margin
- 1.5-2.0mm isthmus width
- 1.5mm minimum depth at bottom of the fissure
- Rounded internal line angles


5

Molar Onlay Preparation

- 1.5-2.0mm isthmus width
- 1.5 mm minimum depth at bottom of the fissure
- Rounded internal line angles
- Butt joint margin
- 1.5-2.0mm minimum layer thickness for cusp preparation

Please refer to instructions for more detailed information as well as precautionary and warranty information.

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3M SIZE CONVERSION AND FLUID RECOMMENDATIONS

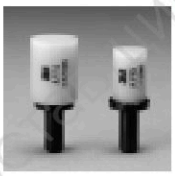
3M™ Paradigm™ MZ100 Block for CEREC®

Selection of proper size of mill block for the restoration to be milled is based upon completion of all design steps required of the restoration. You will be prompted by the CEREC machine to insert a block corresponding to the size of the restoration. Proceed with the following size guidelines.

3M™ Paradigm™ MZ100 block is made in two cylindrical sizes, 10 and 14; these correspond to the CEREC sizes according to the following conversions:

CEREC Size I8, I10 = 3M Size 10

CEREC Size I12, I14, V5-12, V7, K14 = 3M Size 14



3M Paradigm MZ100 Block for CEREC, sizes 14 and 10

Milling Lubricant

Either Sirona™ Dentatec™ or Sirona™ Dentatec ProCAD CEREC Milling Concentrate can be used with 3M Paradigm MZ100 blocks. The recommended level of concentrate 50 to 75 ml can be used. It is important to change the water as indicated by the CEREC software.

Finishing/Polishing and Characterization

Finish occlusal surface using an appropriate finishing instrument. Finish proximal surfaces with 3M™ Sof-Lex™ Pop-on™ extra thin discs and Sof-Lex Strips.

Characterize and stain with light-cure composites (Z100™ Restorative, Z250 Universal Restorative) and standard composite tints.

DO NOT FIRE! Composites are light-cured and should not be placed into a porcelain oven.

Please refer to instructions for more detailed information as well as precautionary and warranty information.

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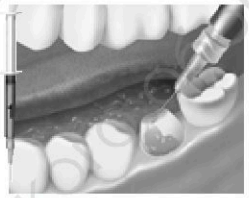
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3M™ RelyX™ Adhesive Resin Cement

Indications:

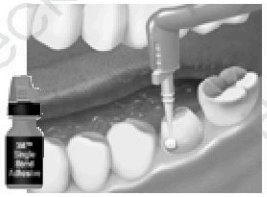
This system is indicated for final cementation of PFM crowns and bridges, CAD/CAM milled composite crowns, crowns with minimal tooth structure, Maryland bridges (resin bonded bridges), or ceramic/porcelain crowns and bridges. In cases where core material is present, roughen the core material and apply all solutions indicated for enamel and dentin.


1

Etchant:

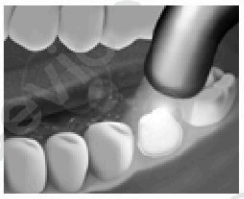
- Apply Scotchbond™ etchant to enamel and dentin - wait 15 seconds.
- Rinse for 10 seconds.
- **Blot excess water leaving tooth moist.***

* Note: A 3M mini-sponge (No. 7522S) or a moist cotton pellet may be used for blotting.


2

Adhesive:

- Apply 2 consecutive coats of 3M™ Single Bond Adhesive to enamel and dentin.
- Dry gently for 5 seconds. **Avoid excess adhesive on all prepared surfaces.**

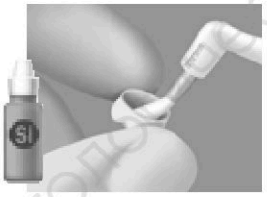

3

Light-Cure:

- Light-cure for 10 seconds per bonding surface.

Bonding Surface Preparation:

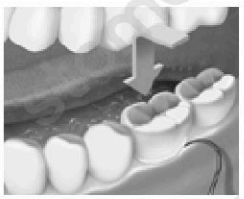
- Roughen the bonding surface of indirect composite crowns with a diamond.
- A CAD/CAM milled surface is sufficient for routine bonding; air abrasion improves bond.
- Apply 3M™ Scotchbond™ Ceramic Primer (#2721) to etched porcelain and roughened metal surfaces.
- Dry for 5 seconds.


4


5

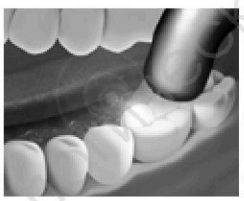
Apply Cement:

- Dispense cement onto a mixing pad and mix for 10 seconds.
- Apply a thin layer of cement to the bonding surface of the crown.


6

Placement:

- Slowly seat the crown.
- Remove excess cement approximately 3-5 minutes after seating. Optional: If excess cement is removed immediately after seating, light-cure margins for 40 seconds after clean-up.


7

Light-Cure:

- Once the crown is seated, margins may be light-cured for 40 seconds or allowed to self-cure for 10 minutes.

Note: For porcelain and pre-cured composite crowns, margins must be light-cured for 40 seconds.


8

Finish and Polish:

- Finish occlusal surface using an appropriate finishing instrument.
- Finish proximal surfaces with 3M™ Sof-Lex™ Pop-on™ extra thin discs and Sof-Lex strips.

Please refer to instructions for more detailed information as well as precautionary and warranty information.

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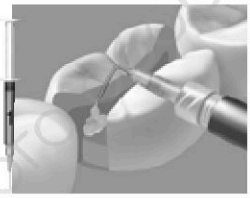
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3M™ RelyX™ ARC Adhesive Resin Cement

Indications:

This system is indicated for final cementation of CAD/CAM milled composites, metal, ceramic, porcelain or pre-cured composite inlays and onlays. Tight-fitting metal restorations should be relieved internally to facilitate complete seating.


1

Etchant:

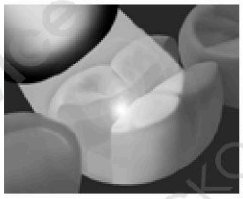
- Apply Scotchbond™ etchant to enamel and dentin - wait 15 seconds.
- Rinse for 10 seconds.
- **Blot excess water leaving tooth moist.***

* Note: A 3M mini-sponge (No. 7522S) or a moist cotton pellet may be used for blotting.


2

Adhesive:

- Apply 2 consecutive coats of 3M™ Single Bond adhesive to enamel and dentin.
- Dry for 5 seconds. **Avoid excess adhesive on all prepared surfaces and line angles.**

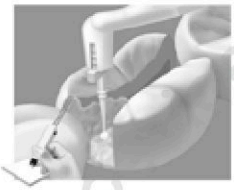

3

Light-Cure:

- Light-cure for 10 seconds.

Bonding Surface Preparation:

- Roughen the bonding surfaces of indirect composite inlays/ onlays with a diamond.
- **A CAD/CAM milled surface is sufficient for routine bonding; air abrasion improves bond.**
- Apply 3M™ RelyX™ Ceramic Primer (#2721) to milled Paradigm MZ100 block, etched porcelain, and roughened metal surfaces.
- Dry for 5 seconds.


4

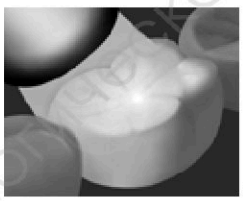
Apply Cement:

- Dispense cement onto a mixing pad and mix for 10 seconds.
- Apply a thin layer of cement onto the preparation.


5

Placement:

- Slowly seat the inlay/onlay.
- While holding in place, remove excess cement immediately after seating.


6

Light-Cure:

- Light-cure margins for 40 seconds.


7

Finish and Polish:

- Finish occlusal surface using an appropriate finishing instrument.
- Finish proximal surfaces with 3M™ Sof-Lex™ Pop-on™ extra thin discs and Sof-Lex strips.

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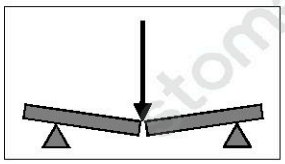
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Physical Properties

Product	Manufacturer
Paradigm™ MZ100 Block for CEREC®	3M™
CEREC® 2 Vitabloc™ Mark II	Vita™ Zahnfabrik H. Rauter GmbH & Co. KG
ProCAD by Ivoclar™	Ivoclar™ North America, Inc.
Artglass™ Paste	Heraeus Kulzer™ GmbH
Belleglass™ HP Dual Cure	SDS KerrLab®
Sculpture™ Resin Based Filling Material	Jeneric/Pentron™, Inc.
Herculite XRV™	Kerr® U.S.A.
Z100™ Restorative	3M™

For compressive strength, diametral tensile strength, Young's Modulus, and fracture toughness, cylindrical samples of Paradigm MZ100 block and Mark II were turned on a lathe; ProCAD could not be prepared in this way.

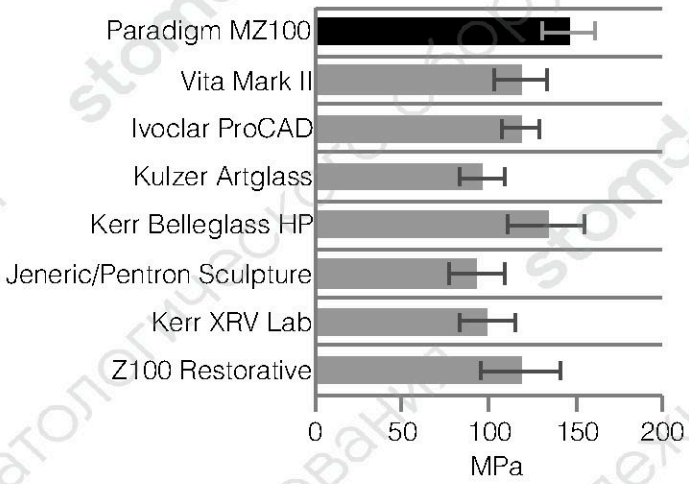
Flexural Strength



Flexural strength is determined in the same test as flexural modulus. Flexural strength is the value obtained when the sample breaks. This test combines the forces found in compression and tension. For flexural strength testing, bars were milled from the block materials (Paradigm MZ100 block, Mark II, ProCAD) on the Sirona® CEREC® 2 system.

The flexural strength of CEREC® milled 3M™ Paradigm™ MZ100 Block is statistically higher than CEREC milled Vita™ Mark II, CEREC milled Ivoclar ProCAD™, XRV Lab, Sculpture™, Artglass™ and 3M™ Z100™ Restorative. Paradigm MZ100 block is similar to Belleglass HP.

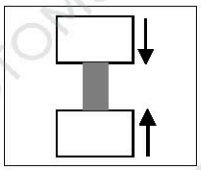
Figure 6.
Flexural Strength



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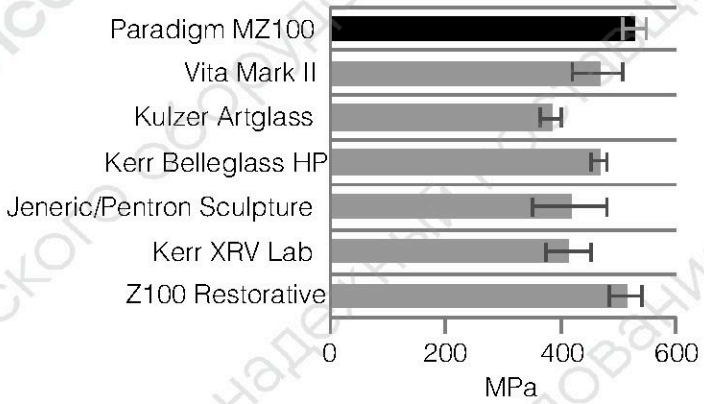
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Compressive and Diametral Strength

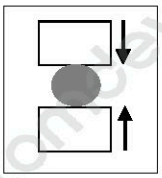


Compressive and diametral strength are particularly important because of chewing forces. Rods are made of the material and simultaneous forces are applied to the opposite ends of the sample length. The sample failure is a result of shear and tensile forces.

Figure 7.
Compressive Strength

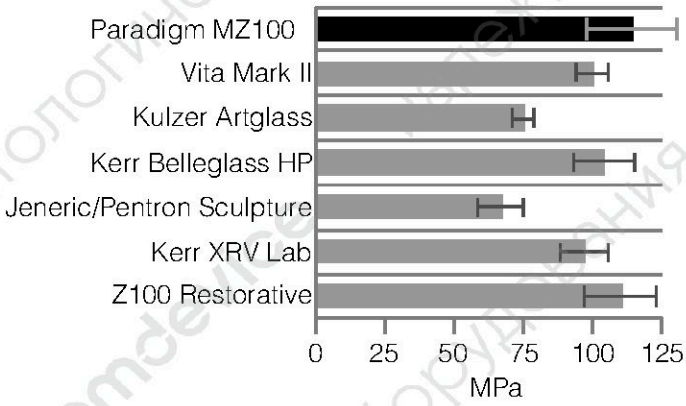


The compressive strength of 3M™ Paradigm™ MZ100 Block for CEREC® is statistically higher than Sculpture™, XRV™ Lab, Artglass™ and statistically similar to Vita™ Mark II, 3M™ Z100™ Restorative and Belleglass™ HP.



Diametral tensile strength is measured using a similar apparatus as for compressive strength. Compressive forces are applied to the sides of the sample, not the ends, until fracture occurs.

Figure 8.
Diametral Tensile Strength



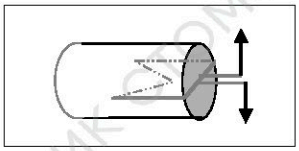
The diametral tensile strength of Paradigm MZ100 block is statistically higher than Vita Mark II, Sculpture, XRV Lab, and Artglass. Paradigm MZ100 block is statistically similar to Z100 restorative and Belleglass HP.

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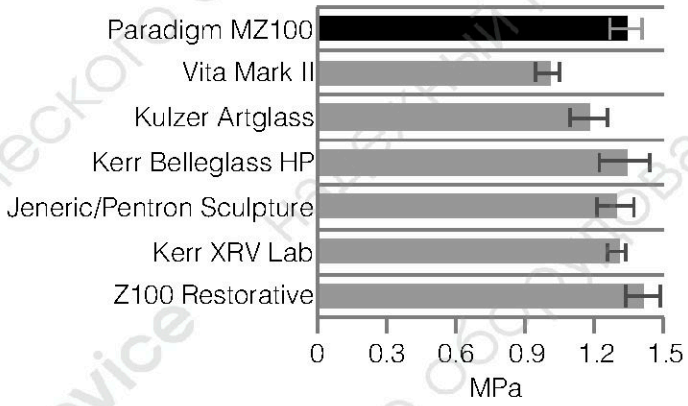
Fracture Toughness

The values reported for fracture toughness (K_{IC}) are related to the energy required to propagate a crack. In this test a short rod of material is cured. A chevron or notch is cut into the cylinder and the parts on either side of the chevron are pulled apart.



The fracture toughness (K_{IC}) of 3M™ Paradigm™ MZ100 Block for CEREC® is statistically greater than Vita™ Mark II porcelain blocks and are statistically similar to Kerr XRV™ Lab, Kerr Belleglass™ HP, Kulzer Artglass™ and 3M™ Z100 Restorative.

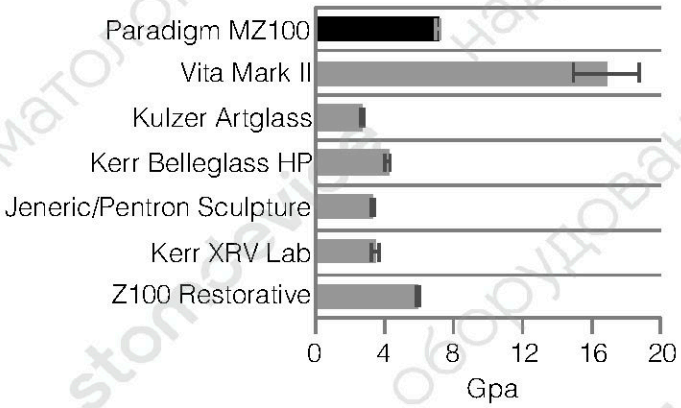
Figure 9.
Fracture Toughness



Young's Modulus

The Young's or compressive modulus of Paradigm MZ100 is statistically lower than Vita Mark II and statistically higher than Sculpture™, Artglass™, XRV Lab, 3M™ Z100™ Restorative and Belleglass HP.

Figure 10.
Young's Modulus



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Flexural Modulus

Flexural modulus is a method of defining a material's stiffness. A low modulus indicates a flexible material. The flexural modulus is measured by applying a load to a material specimen that is supported at each end.

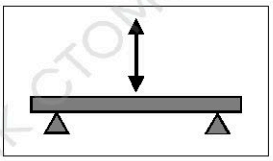
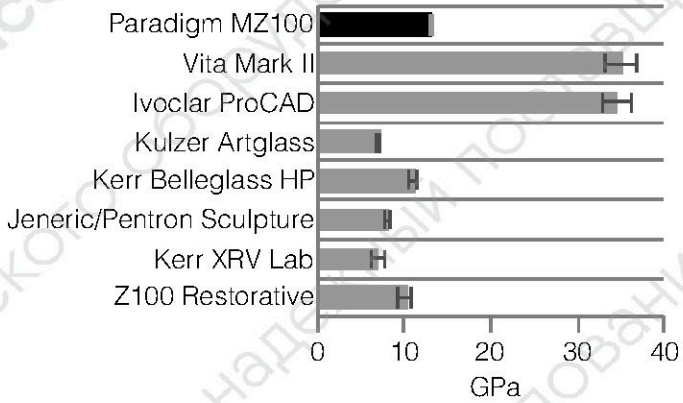


Figure 11.
Flexural Modulus

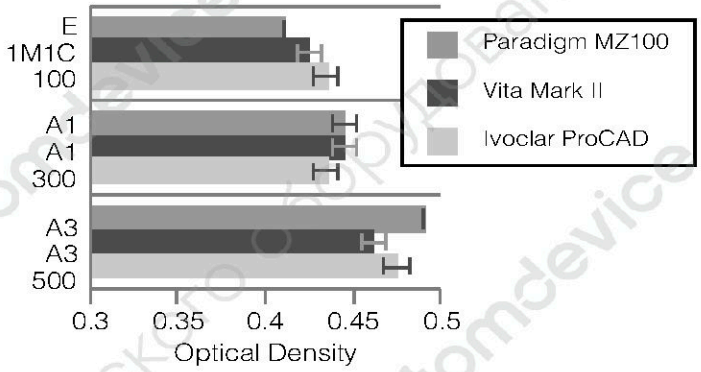


3M™ Paradigm™ MZ100 Block for CEREC® is statistically lower than Vita™ Mark II, ProCAD and higher than Artglass™, Belleglass™, Sculpture™, XRV™ and 3M™ Z100™ Restorative.

Visual Opacity

Optical density is a measure of visual opacity. It is a unitless quantity where higher values signify higher visual opacity. The optical density of the lightest shade of Paradigm MZ100 (shade E) is statistically lower (i.e. more translucent) than the lightest shade of Mark II (shade 1M1C) and ProCAD (shade 100). The optical density of Paradigm MZ100 shade A1, Mark II shade A1, and ProCAD shade 300 are statistically similar. The optical density of Paradigm MZ100 shade A3 is statistically higher than Mark II shade A3 and ProCAD shade 500.

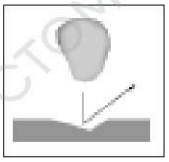
Figure 12.
Optical Density



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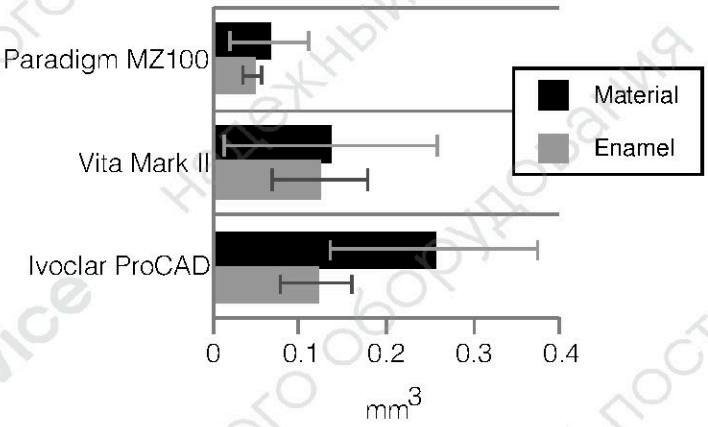
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Two-Body Wear

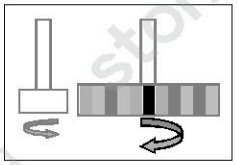


Two-body wear of human enamel on the test material was measured at the Minnesota Dental Research Center for Biomechanics and Biomaterials (MDRCBB) at the University of Minnesota. In this test developed by DeLong et al, a human third molar palatal cusp abrades the test material in a computer-controlled motion that mimics natural chewing. The surface topography of the enamel and test material is profiled before and after abrasion with a contact digitizer, allowing the mean depth change and material volume loss to be determined. The volume loss of enamel against 3M™ Paradigm™ MZ100 Block for CEREC® is statistically lower than against Vita™ Mark II or ProCAD. The volume loss of Paradigm MZ100 block against enamel is statistically lower than Mark II or ProCAD.

Figure 13.
Two-Body Wear
Volume Loss



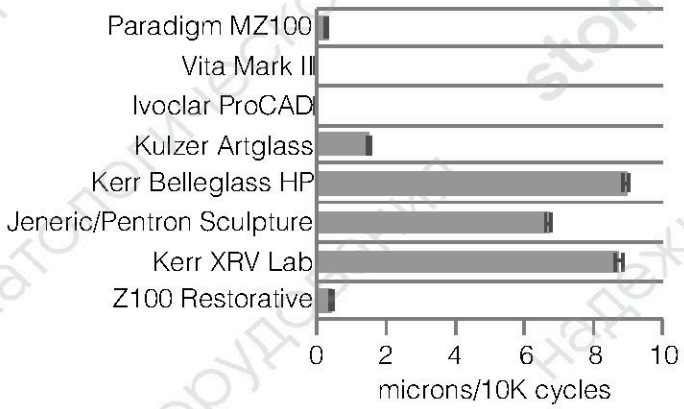
Three-Body Wear



The *in vitro* wear rate was measured in the ACTA wear machine, a 3-body abrasion testing machine (Pallav, et al). In this test, composite (1st body) is loaded onto a wheel (shaded slots in the diagram) which contacts another wheel which acts as an "antagonistic cusp" (2nd body). The two wheels counter-rotate against one another dragging an abrasive slurry (3rd body) between them. Dimensional loss during 156,000 cycles is determined by profilometry at regular intervals. As the wear in this method typically follows a linear pattern, the data is plotted using linear regression. The wear rates, i.e., the slope of the lines, are determined. The comparison of rates reduces some of the variability in the test due to sample preparation and can be predictive of anticipated wear beyond the length of the actual test.

The three-body wear rate of Paradigm MZ100 block is statistically lower than that of Artglass, Belleglass, Sculpture, and XRV, and statistically higher than that of Mark II and ProCAD.

Figure 14.
Three-Body Wear



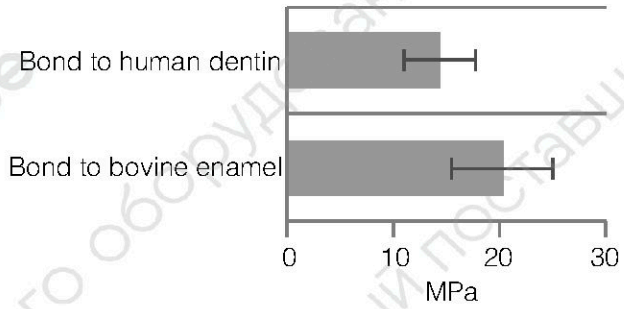
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Shear Bond Strength to Tooth

The shear bond strength of 3M™ Paradigm™ MZ100 Block for CEREC® to bovine enamel and human dentin was measured using RelyX ARC adhesive resin cement.

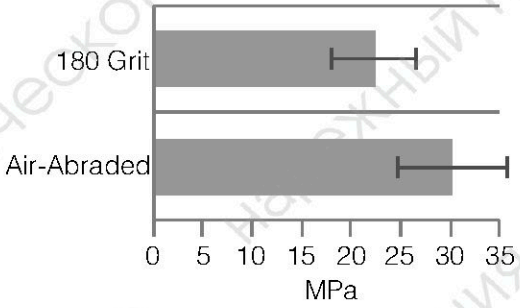
Figure15.
Shear Bond Strength



Bond of Cement to Paradigm MZ100 Material

The shear bond strength of 3M™ RelyX™ ARC Adhesive Resin Cement to Paradigm MZ100 block was measured at the University of North Carolina (Sturdevant, et al). Buttons of Paradigm MZ100 material were bonded to Paradigm MZ100 substrates with RelyX ARC adhesive resin cement. Two different roughening treatments were applied to the Paradigm MZ100 blocks: (a) 180 grit silicon carbide sandpaper (which approximates the as-milled surface), or (b) air abrasion with 50 mm aluminum oxide. The authors stated that "fractures were almost always cohesive failures in the composite substrate, indicating good adhesion between cement and substrate." The adhesion was statistically higher for the air abrasion treatment.

Figure 16.
Bond Strength to 3M™ Paradigm™ MZ100 Material, University of North Carolina



Radiopacity

Radiopacity was measured according to ISO DIS 4049: 1998. Paradigm MZ100 block material is radiopaque. Ivoclar ProCAD material, Kerr Herculite XRV material, Jeneric/ Pentron Sculpture material, Kerr Belleglass HP and Heraeus Kulzer Artglass materials are also radiopaque, whereas Vita Mark II material is not radiopaque.

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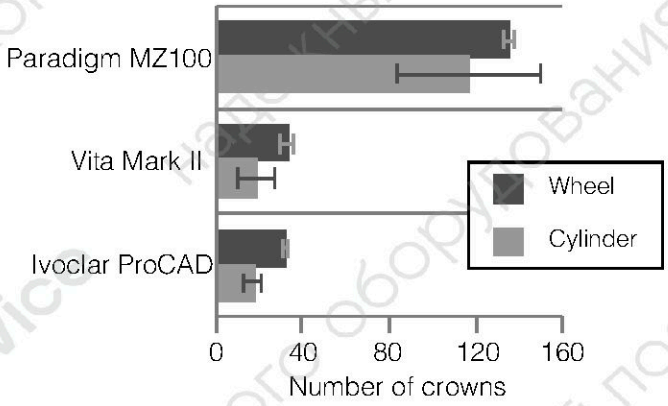
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Tool Life

Full molar crown restorations were milled on a Sirona™ CEREC®2 System per manufacturers' instructions. Tool life was determined by milling crowns until the software indicated a tool change was required.

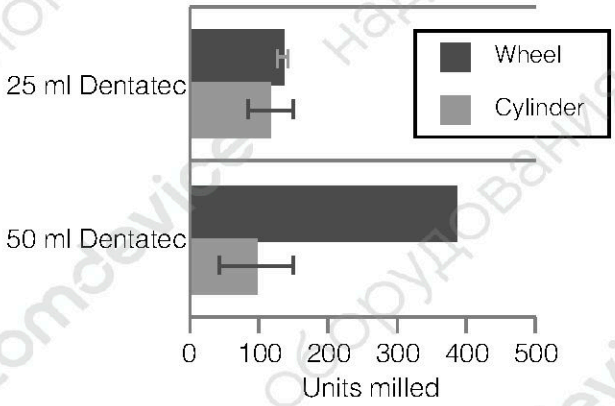
The graph below shows the lifetime of the diamond wheel and cylinder for each type of block material tested. Twenty-five ml of Sirona™ Dentatec™ Milling Concentrate was used for the 3M™ Paradigm™ MZ100 Blocks for CEREC. Manufacturers' instructions for milling concentrate were followed for Vita™ Mark II and Ivoclar ProCAD blocks. The lifetime for both the wheel and the cylinder is statistically higher milling Paradigm MZ100 blocks than Vita Mark II blocks or ProCAD blocks, when only Paradigm MZ100 blocks are milled, exclusively.

Figure 17.
Tool Lifetime



Tool lifetime for milling Paradigm MZ100 blocks using 25 ml or 50 ml of milling concentrate is shown below. While the cylinder lifetime is statistically similar, the wheel lifetime is significantly longer with the higher level of milling concentrate.

Figure 18.
Tool Lifetime

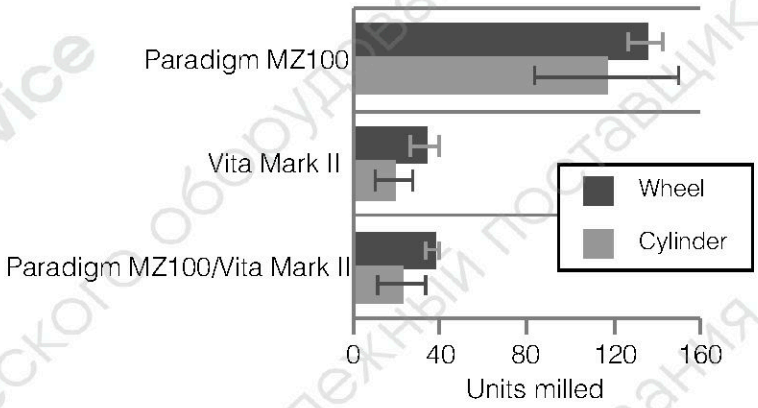


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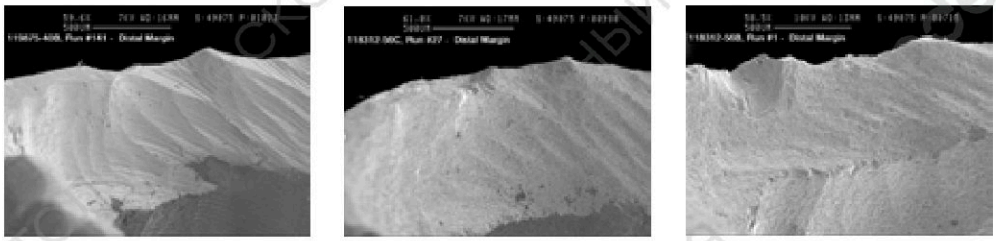
The third graph shows tool lifetime when milling 3M™ Paradigm™ MZ100 Block for CEREC® and Vita Mark II blocks are milled as separate groups, and also when alternating one after the other. When the composite and porcelain blocks are alternated, the tool lifetime is the same as when porcelain blocks alone are milled.

Figure 19.
Tool Lifetime



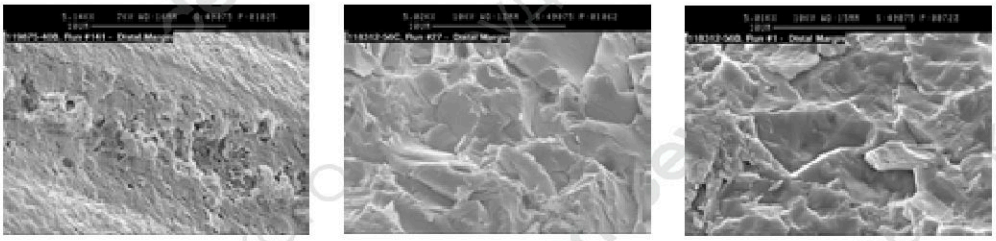
The SEM micrographs below show the margins of milled crowns of Paradigm MZ100 block material, Mark II material, and ProCAD material. While the same broad contours and peaks can be seen in all three, which is reflective of the margin shape, the margin edge appears more sharply defined in the Paradigm MZ100 block material compared to the porcelain materials. In addition, the porcelain margins show chipping. Large milling grooves matching the outer shape of the tool can be seen in all three. Smaller grooves resulting from individual diamond grains can be seen on the Paradigm MZ100 block material, but not on the porcelains.

Distal Margins
60x magnification
(l to r: 3M™ Paradigm™ MZ100, Vita Mark II, Ivoclar ProCAD)



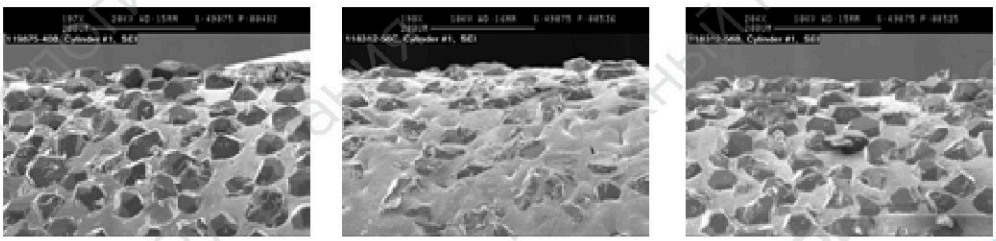
The micrographs below show the milled surface at higher magnification. Fine grooves can be seen in the Paradigm MZ100 material, indicating a plastic deformation mechanism of material removal. The porcelain materials, by contrast, exhibit a surface typical of a fracture mechanism of material removal.

Distal Margins
5000x magnification
(l to r: 3M™ Paradigm™ MZ100, Vita Mark II, Ivoclar ProCAD)



Worn cylinders are shown in the micrographs below. Some debris is present on the tools, but none are clogged with material. The cylinder for Vita Mark II shows a significant number of missing diamond grains; the cylinder for ProCAD shows a number of fractured grains.

Worn Cylinder
(l to r: 3M™ Paradigm™ MZ100, Vita Mark II, Ivoclar ProCAD)



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3M Products For CEREC ® Procedures

3M offers a system of products for use in CEREC procedures, in addition to 3M™ Paradigm™ MZ100 Block for CEREC®.

Core Buildup:	
3M™ Filtek™ Z250 Universal Restorative 3M™ Z100™ Restorative 3M™ F2000 Compomer Restorative 3M™ Vitremer™ Core Buildup/Restorative	• A strong foundation for a superior restoration
Liner/Base:	
3M™ Vitrebond™ Light Cure Glass Ionomer Liner/Base	• Reduces microleakage, which helps reduce sensitivity • Antimicrobial action and fluoride release
Adhesive Cementation:	
3M™ RelyX™ ARC Adhesive Resin Cement	• Easy seating, but does not run • Easy "flick" cleanup during intermediate waxy stage of cure • Precise, controlled-dose dispensing with the Clicker™ Dispenser
Flowable Composite Liner:	
3M™ Filtek™ Flow Flowable Restorative	• Flows when you brush it, does not run
Finishing and Polishing:	
3M™ Sof-Lex™ Finishing and Polishing Discs	• Superb finishing for composites and porcelains from the world's leader in abrasives (Karpetian, et al)
Impression Materials:	
3M™ Imprint™ Impression Material 3M™ Imprint™ II Impression Material 3M™ Express™ Impression Material	• Fast and accurate
Temporization:	
3M™ IsoTemp™ Temporary Material 3M™ Prefabricated Crowns	• Fast and easy to use

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Questions and Answers

Why is the mill block made from 3M™ Z100 Restorative Material and not the new 3M™ Filtek™ Z250 Universal Restorative Material?

Some of the primary benefits of the Filtek Z250 restorative material compared to Z100 restorative material are improved handling in paste form, less shrinkage during cure and shorter cure time. These features are not relevant in a cured block.

Throughout our early investigations we learned that clinical history, primarily as it relates to long term wear, is of critical importance to any dentist considering evaluating a new material for a CAD/CAM indirect restoration. Z100 restorative has an excellent track record with clinical studies to support wear properties. We expect wear of the industrially cured block to be as good or better than Z100 restorative placed and cured directly in the mouth. Dentists were immediately comfortable working with the material once we identified the mill block as being made from Z100 restorative.

Is 3M™ Paradigm™ MZ100 Block for CEREC® Radiopaque?

Yes, Paradigm MZ100 block is radiopaque. Ivoclar™ ProCAD, Kerr XRV™ Lab, Jeneric/Pentron Sculpture™, Kerr Belleglass HP, and Artglass™ are radiopaque. Vita™ Mark II is not radiopaque.

What is the rate of conversion of the methacrylate groups in Paradigm MZ100 Block vs Z100 restorative direct cured ?

The conversion of the methacrylate groups via FTIR is 84% for Paradigm MZ100 block vs. 74% for the Z100 restorative material directly placed and light cured.

What is the recommended cement for this type of material?

The required cement is an adhesive resin cement such as 3M™ RelyX™ ARC Adhesive Resin Cement.

Why is the shape of the block round?

A variety of shapes were considered and evaluated. The cylindrical shape creates a strikingly different look for a material that offers unique benefits. In addition, the round shape echoes the rounded contours of natural tooth anatomy.

Why are there only two block sizes?

Since the Paradigm MZ100 block causes less wear on the diamond tools, only two sizes are needed to mill all of the indicated restorations. Fewer sizes mean less material to purchase and inventory.

I can stain and glaze porcelain. Can I do the same with Paradigm MZ100 restorations?

Paradigm MZ100 block material can be characterized with fast, easy-to-use light cured composites and stains. While a glaze firing is usually required to obtain optimal strength in porcelains, Paradigm MZ100 restorations require only polishing. Paradigm MZ100 material should NOT be fired.

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Instructions

3M™ Paradigm™ MZ100 Block for CEREC®

General

3M™ Paradigm™ MZ100 Block for CEREC® is a strong, wear-resistant and highly esthetic mill block that provides a fast and easy-to-use, in-office alternative to porcelain blocks for milling CAD/CAM indirect restorations. Made from 3M™ Z100™ Restorative, the material is specially processed to enhance its properties for use in CAD/CAM milling procedures. The filler is zirconia silica. The inorganic filler loading is 85% by weight with an average particle size of 0.6 micron. Paradigm MZ100 block contains BISGMA and TEGDMA resins. Paradigm MZ100 block material is radiopaque.

Indications

3M™ Paradigm™ MZ100 Block for CEREC® is indicated for inlay, onlay, veneer and full crown restorations. Paradigm MZ100 block is not indicated for an implant material. *Paradigm MZ100 block is not recommended for bruxers or clenchers.*

Preparation

Proper reduction of the tooth/teeth is essential for optimum strength, color and retention of a milled full crown or onlay.

Inlay and Onlay

Traditional inlay/onlay design is recommended. Do not undercut. Taper cavity walls 5-6 degrees to the long axis of the preparation. All internal edges and angles should be rounded to avoid internal stress. Incisal/occlusal reduction is 1.5 to 2 mm clearance in centric occlusion and all excursions.

Full Crown

Axial reduction is 1.2 to 1.5 mm with a 5-6 degree taper. Incisal/occlusal reduction is 1.5 to 2 mm clearance in centric occlusion and all excursions. Shoulder must extend at least 1.0mm lingual to proximal contact area. Non-beveled shoulder finish lines are recommended. All line angles should be rounded and preparation surfaces smooth.

Veneer

Standard reduction of the labial surface is 0.6 mm and 0.4 mm at the gingival portion because the enamel is thinner in this area. The reduction of the incisal, labial-lingual angle is 0.5 to 1.5 mm. Margins for the veneers should be above the gingival tissues 0.4 to 0.6 mm deep. Chamfer or rounded shoulder should be used for all preparations. Proximal extensions should be far enough into the proximal so margins do not show and have no proximal-gingival undercuts.

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Pulp Protection

If a near-pulp or pulp exposure has occurred, use a calcium hydroxide layer first, followed by an application of 3M™ Vitrebond™ Liner/Base to minimize sensitivity.

Temporization

Place a provisional restoration on tooth if protection is needed until permanent restoration is cemented (3M™ Iso-Temp™ Temporary Material, No. 4500 or Iso-Form™ Crowns, No. MC-64, BC-64). A non-eugenol cement is recommended for cementation of the temporary restoration.

Milling and Block Sizes

Selection of proper size of mill block for the restoration to be milled is based on completion of all design steps required of the restoration. You will be prompted by the CEREC® machine to insert a block corresponding to the size of the restoration. Proceed with the following size guidelines.

CEREC Size I8, I10 = 3M Size 10
CEREC Size I12, I14, V5-12, V7, K14 = 3M Size 14

Milling Lubricant

Either Sirona™ Dentatec™ or Sirona Dentatec ProCAD CEREC® Milling Concentrate can be used with 3M™ Paradigm™ MZ100 Blocks. The recommended level of concentrate is 50 ml per reservoir tank-full; any level from 50 to 75 ml can be used. It is important to change the water as indicated by the CEREC software.

Restoration Finishing

1. Remove temporary restoration and clean tooth thoroughly. Trial fit to preparation. Adjust contacts and occlusion as necessary.
2. Reduce/smooth with 3M™ Sof-Lex™ Finishing and Polishing Discs. Use the coarse or medium discs for general contouring of the crown, inlay or onlay.
3. Cut-in or develop additional occlusal anatomy with 12 bladed fluted carbide burs.
4. Smooth the remaining surfaces of the restoration with a fine or super-fine Sof-Lex disc.
5. Apply a diamond polish paste or denture polishing compound with a soft bristle brush.
6. For deep occlusal polishing use the stiff bristle brush loaded with polishing agent.
7. Use a small muslin rag wheel to produce a high shine.
8. Clean polished restoration in an ultrasonic cleaner or steam cleaner, gently blow dry with air syringe.

Bonding Instructions for Paradigm MZ100 Block Restorations

1. Trial-fit the final restoration with light finger pressure to evaluate the fit, shade and marginal integrity. Adjust if necessary.
2. The as-milled surface is sufficiently rough for routine bonding. Sandblasting with

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50µm alumina has been found to improve the bond strength by approximately 30%. **Thoroughly clean after sandblasting**. (Cement Bond Strength to Millable Composite for CAD/CAM Restorations. J.R. Sturdevant, E.J. Swift, Jr., and S.C. Bayne (Journal of Dental Research, Vol. 79, Special Issue 2000, Abstract 2479)

3. Silane treatment: Apply 3M™ RelyX™ Ceramic Primer (Item No. 2721) to the bonding surface of the restoration. Dry for 5 seconds.
4. Clean the prepared teeth in preparation for seating and bonding using a plain flour of pumice slurry. Rinse and dry thoroughly, isolate from moisture and adjacent teeth.
5. Etching: Apply 3M™ Scotchbond™ Etchant (Phosphoric Acid) (Item No. 7523) to both enamel and dentin. Wait 15 seconds. Rinse for 10 seconds. Blot excess water leaving tooth moist.
6. Adhesive: Apply 2 consecutive coats of 3M™ Single Bond (Item No. 3411) Dental Adhesive to etched enamel and dentin. Dry for 5 seconds being careful to avoid excess adhesive on all prepared surfaces.
7. Light cure preparation for 10 seconds per bonding surface.
8. Dispense the appropriate amount of 3M™ RelyX ARC™ Adhesive Resin Cement (Item No. 3415A1 or 3415A3) onto a mixing pad and mix for 10 seconds.
9. Apply and evenly distribute a thin layer of cement to the bonding surface of the indirect restoration.
10. Slowly seat and hold restoration in proper occlusion. Begin cleanup of excess cement approximately 3-5 minutes after seating. **Optional: if excess cement is removed immediately after seating, each cement surface/margin must be light-cured for 40 seconds.**
11. Once the restoration is seated and the margins have been cleaned, light cure each cement margin for 40 seconds or allow to self-cure for 10 minutes.
12. Instruct patient to avoid applying any pressure for 10-15 minutes.

Directions for Buildup or Adding-on

Buildup or polymer addition can be made to a 3M™ Paradigm™ MZ100 Block for CEREC® restoration intraorally or extraorally using 3M™ Filtek™ Z250 Universal Restorative or 3M™ Z100™ Restorative with the following technique.

1. **Extraorally** roughen site to be added to with a coarse diamond, stone or air-abrade (sandblast with 50mm aluminum oxide).
2. **Intraorally** roughen site to be added to with a coarse diamond, stone or if available intraoral air abrasion unit. Rinse and clean prepped site then dry. Phosphoric acid etchant may be used to clean site of roughened area, rinse etchant thoroughly, blow dry.
3. **Clean** restoration in an ultra-sonic cleaner with normal detergent type cleaners, then brush on 3M™ RelyX™ Ceramic Primer (Item No. 2721) to the roughened area and dry for 5 seconds.
4. **Brush** on two thin layers of Single Bond dental adhesive (Item No. 3411) to the roughened area and gently blow dry for 2-5 seconds to evaporate ethanol solvent.

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5. **Light-cure** adhesive for 10 seconds.

   **Apply/buildup or additional polymer to area required then light cure for 40 seconds.

   **Note: To avoid "white-line" at the edges of the add-on site brush additional Single Bond dental adhesive to the borders of the add-on and light cure both additional polymer and 3M Single Bond dental adhesive.

6. **Shape** and smooth addition with 3M™ Sof-Lex™ Contouring and Polishing Discs (Item No. 1980).

7. **Polish** to a high shine with a small muslin rag wheel or soft bristle brush and white diamond or diamond paste.

Storage and Use

1. Shelf life of 3M™ Paradigm™ Block for CEREC® is five years at conditions of 10-26° C/50-80°F. Do not store mill blanks in intense light or sunlight.
2. The mill blank composite materials are designed for use at room temperature of approximately 21-24° C/70-75° F.
3. Do not expose restorative to elevated temperature.
4. Do not store materials in proximity to eugenol containing products.

Warranty

3M will replace product that is proven to be defective. 3M does not accept liability for the loss or damage, direct or consequential, arising out of the use or inability to use these products. Before using, the user shall determine the suitability of the product for its intended use and user assumes all risk and liability whatsoever in connection therewith.

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